On Zooplankton of Some Arctic Coastal Lagoons of Northwestern Alaska, with Description of a New Species of *Eurytemora*

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A characteristic feature of the low-lying Alaskan coast of the Chukchi Sea is the presence of a more or less broken beadlike series of "lagoons" extending from Cape Prince of Wales to Point Barrow. The general scientific interest in these lagoons is succinctly summarized by R. H. Fleming and staff in a preliminary report on the "Brown Bear" cruise no. 236 in 1959:

The geological and oceanographic processes that have led to development and life history of these features are of major scientific interest. Because each of them may represent a variable but unique micro-environment, the biology of these lagoons is also of unusual interest because they represent a transitional series of marine to fresh-water environments. At one extreme these lagoons are, in effect, the complex estuaries of rivers that flow only during the summer. At the other extreme the older lagoons, now permanently isolated from the sea and clogged with sediment and vegetation, are only distinguishable from aerial photographs. Between these two extremes are bodies of water, varying greatly in size, that must from time to time be flooded with sea water and then are closed off again and slowly diluted by the accumulation of precipitation and runoff.

During August 4–15, 1959, an opportunity was provided by the U. S. Atomic Energy Commission's Committee for Environmental Studies of Project Chariot and the University of Washington Department of Oceanography[2] to conduct a survey of the plankton in a number of these more or less landlocked lagoons situated at the immediate coast in the region of Cape Thompson, Alaska. The samples collected, being from various lagoons, are important in providing a broad picture of the deviations or similarities that characterize the populations of these bodies of water. The fauna encountered are of special interest in furthering our knowledge of the geographic distribution, biology, and taxonomic status of certain calanoid copepod species that are in varying degrees transitional between the purely marine and fresh-water forms.

Prior to the initiation of this project, there had apparently been no study of the zooplankton of these remote and relatively inaccessible lagoons. Some studies that provide especially useful records for comparison have been made previously of the offshore plankton of the Alaskan coast of the Chukchi and Beaufort seas (Willey, 1920; Johnson, 1953, 1956), and in ponds situated at Point Barrow (Comita and Edmondson, 1953; Comita, 1956; Johnson, 1958). Coincident with the present restricted study, a general plankton survey was made in the offshore waters of portions of Chukchi and Bering seas by members of the University of Washington Oceanographic Department aboard the "Brown Bear" (R. H. Fleming and staff, 1959).

It is a pleasure to thank Dr. Richard H. Fleming for providing this opportunity to participate in the research expedition of the University of Washington oceanographic vessel "Brown Bear" to the Chukchi Sea area. The assistance of Dr. Norman J. Wilimovsky, Philip Buscemi, and Howard Smith in the field is gratefully acknowledged, as is also the cooperation of the administrators and contractors of the project site. The water samples were titrated for chlorinity by the Geological Survey laboratory at the project camp site.

PROCEDURE AND RESULTS

The plankton samples were collected with a 30-cm. net, 1 m. long, constructed of no. 6 bolting cloth. An inflated rubber boat was used

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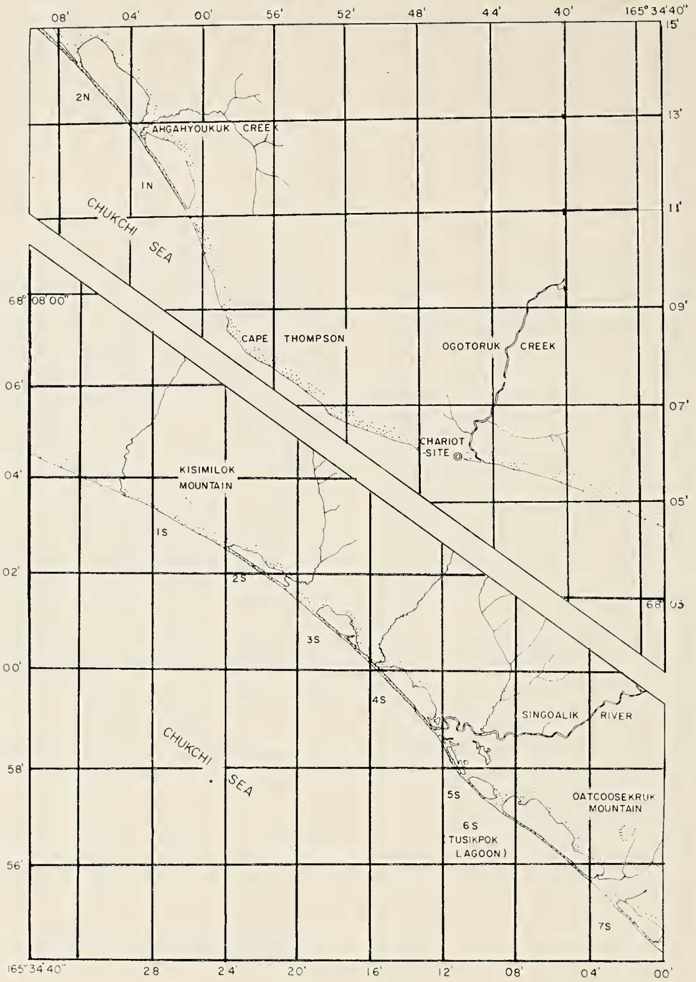


FIG. 1. Numbered lagoons sampled in the Cape Thompson, Alaska area. Based on U. S. Coast and Geodetic Survey Topographic Map T-9425 Alaska.

while obtaining the deeper hauls and the water samples. Most surface hauls were made by wading along shore with the net attached to the end of a pole.

Lagoons

The position, approximate size, and identification of the lagoons sampled are shown in Figure 1. Cape Thompson divides them geographically into a northern and a southern group, as numbered in Figure 1. The only lagoon for which a name occurs on U.S.C. and G.S. Topographic Map T-9423, on which Figure 1 is based, is Tusikpok, which corresponds to no. 6 south. All of the lagoons are shallow; the depths at the positions of sampling (about one-half the distance across the lagoon) were from 1.3 to 3 m., and, as anticipated from wind conditions and shallowness, they showed only moderate or no thermal or haline stratification except in no. 2 south where the salinity at the bottom was 1.65 per mille higher than that at the surface (Table 1). It is clear that they are at times subject to invasion of salt water from the sea. This is evidenced by the brackish water of some, by high wave-washed channels on the gravel berms separating the lagoons from the sea, and, in several instances, by the presence of marine and brackish water animals found in the plankton of some lagoons. Lagoons no. 2

TABLE 1

WATER TEMPERATURE AND SALINITY IN COASTAL LAGOONS IMMEDIATELY SOUTH AND NORTH OF CAPE THOMPSON, ALASKA, AUG. 1959

(The lower sample was taken just above the bottom depth indicated)

LAGOON	TEMP. °C.	SALINITY ‰
Lagoon no. 1 south, Aug. 12		
surface	11.0	0.83
bottom (1.5 m.)	11.0	0.83
Lagoon no. 2 south, Aug. 12		
surface	11.2	14.31
bottom (1.3 m.)	11.1	15.96
Lagoon no. 3 south, Aug. 12		
surface	11.0	0.16
bottom (2.1 m.)	10.4	0.17
Lagoon no. 4 south, Aug. 13		
surface	12.3	6.42
bottom (1.3 m.)	12.1	7.16
Lagoon no. 5 south, Aug. 13		
surface	13.6	0.83
bottom (1.3 m.)	13.6	0.83
Lagoon no. 6 south, Aug. 13		
surface	12.6	0.73
bottom (2.4 m.)	12.4	0.73
Lagoon no. 7 south, Aug. 13		
surface	12.6	3.58
bottom (2 m.)	12.1	3.58
Lagoon no. 1 north, Aug. 14		
surface	13.5	0.18
bottom (3 m.)	13.0	0.18
Lagoon no. 2 north, Aug. 15		
surface	13.8	0.46
bottom (2.5 m.)	13.0	0.55

and 4 south each have a narrow above-sea-level outlet that probably floods with sea water during high storms and undoubtedly accounts for the higher salinities observed there.

Judged by the composition of the contained zooplankton, the lagoons are strikingly dissimilar ecologically. How persistent this dissimilarity is cannot be said from this preliminary survey. Basically, the differences probably arise from the geographic position of each lagoon with respect to (1) extent of influx of fresh water in relation to the amount and frequency of that which spills over from the sea during high winds, (2) the height of the lagoon with respect to sea level, and (3) the effectiveness of the berm in serving as a barrier (reinforced by permafrost?) to water percolating out from the lagoon through the gravel. However, the environmental conditions characteristic of each lagoon have been sufficiently unique in the immediate past to permit selection and development of one or two species to a position of overwhelming dominance numerically, as shown by the analysis of the plankton fauna.

Zooplankton

The percentage composition of the fauna is shown in Table 2. Specific attention was given mainly to the calanoid copepods, because of the interest that some of the species hold as transitory forms or as permanent residents in the overlapping environmental conditions between the sea and fresh water. In all cases the populations were composed dominantly of fresh-water or brackish-water forms. But in lagoon no. 2 south, there was a conspicuous element of marine plankton, which was probably only recently recruited from the sea (Table 2). Although *Acartia bifilosa,* a brackish-water species, was overwhelmingly dominant in this lagoon, several marine copepods were also present, but no larval stages of any species were found that might indicate local production. However, if only one generation is produced each year in the lagoon, as is common in some Arctic lakes, the season of nauplii-hatching was probably about past. Most of the marine species found are considered typical of strongly neritic waters, but *Calanus finmarchicus, Pseudocalanus minutus,* and *Acartia longiremis* do also occur well offshore and are very common in the Chukchi Sea, especially off the eastern coast and well north into the Arctic.

Eurytemora pacifica is one of the more infrequent neritic species encountered. Rather little is known regarding its preferred habitat. Hitherto, on the Alaskan coast it has been taken only at Grantley Harbor, and in the region of Point Hope, where it was reported by Willey (1920) as *E. johanseni* n. sp. Excepting lagoon no. 2 south, it was not found in any of the present lagoons, but it was common in a tow taken immediately offshore from lagoon no. 1 north. It is also common in Kivalina Lagoon, where it constituted 7 per cent of the calanoids in a sample kindly provided by Mr. Robert W. Owen of

TABLE 2

PERCENTAGE COMPOSITION BY NUMBER OF PLANKTON IN COASTAL LAGOONS IMMEDIATELY SOUTH AND NORTH OF CAPE THOMPSON, ALASKA
(c = common; + = present, but neither in sufficiently large numbers to constitute 1 per cent of population)

	LAGOONS SOUTH														LAGOONS NORTH			
	1		2		3		4		5		6		7		1		2	
Date of sampling	6	12	6	12	6	12	6	13	6	13	6	13	6	13	14	15	5	15
Surface or bottom	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B
Arcartia bifilosa			78	90			90	12	c									
A. clausi			2						+									
A. longiremis			18	8														
Calanus finmarchicus			+															
Centropages abdominalis			c	+														
Cyclops spp.	65	12				+	+	4	c	c	2	c	+	+	c	1	1	+
Eurytemora canadensis	3					1		+	+	+	3		c	3				
E. herdmani			c	c														
E. pacifica			+	+														
E. foveola, n. sp.											95	90			99	98	57	28
Limnocalanus grimaldi															c	c		
L. johanseni	28	81			c	1	+		96	38		+	14	17	c	c	1	15
Pseudocalanus minutus			1	+														
Tortanus discaudatus			c	c														
Harpacticoids			+	1	+	+	5	72	+	+								
Daphnia	2	6			99	97	+		c	37	+	85	80				40	57
Podon			+	+			1	12										
Evadne			+				+	+										
Clam shrimp	2	1			+				3	25								
Fairy shrimp (Anostraca)	c																	
Ostracods		+		+		+	+				+							+
Neomysis (juvenile)								+										
Sagitta			+															
Fish larvae (total found)				3				7										
Rotifer												9						

the University of Washington from collections made near the outlet on Aug. 22, 1959. These are the only known locality records for the American coast. Elsewhere the species occurs on the Asian coast.

The other neritic species encountered are quite common in small numbers on the Alaskan coast to Point Barrow and in diminishing numbers eastward (Johnson, 1953, 1956).

In lagoon no. 4 south, the plankton was sparse and *Acartia bifilosa* was the most numerous copepod in the surface water on Aug. 6, but an unidentified harpacticoid was the dominant form at the bottom on Aug. 13. It is probably a benthic species since the net contained much bottom debris. Intermingled in the plankton on both dates were the neritic cladocerans, *Podon* and *Evadne*, as the chief evidence of marine invasion.

The plankton fauna of all of the remaining lagoons in the numbered series was characteristically fresh-water. However, there was still a strange marine affinity evidenced by the presence of *Limnocalanus grimaldi* and *L. johanseni*. The former species was common in lagoon no. 1 north, and the latter in all other lagoons with the exception of no. 2 south. The species of this copepod genus have long been the subject of much speculation with respect to their geographic distribution and affinities to the sea. One species, *L. macrurus*, commonly occurs in deep fresh-water lakes, and is generally believed to be a marine relict of glacial times. *L. grimaldi* is an Arctic marine and brackish-water form occurring along the Arctic coast of the U.S.S.R. and is also considered to be a relict of Arctic fauna when found in such widely different isolated localities as the Caspian Sea, the Gulf of Bothnia, and the Baltic Sea. Aside from its present occurrence in lagoon no. 1 north, it has been reported from the Alaskan coast on two previous occasions, once from a collection taken about 100 yd. from the shore at Collinson Point (Willey, 1920), and once at a series of nine offshore stations in the same region, and off the mouth of the Colville River (Johnson, 1956). The present discovery is therefore of special interest in extending the known range of the species on the Alaskan coast, and in recording its occurrence in virtually fresh water, together with *Eurytemora foveola* n. sp. that apparently thrives best at very low salinities.

Less is known about the distribution of *Limnocalanus johanseni*. It was originally described by Marsh (1920) from a fresh-water pond at Collinson Point, just inland from, but not connected with, the shore where Willey recorded *L. grimaldi*. Subsequently, Comita and Edmondson (1953) reported it from Imikpuk Lake, a fresh-water lake near Point Barrow. In the present survey it was a conspicuous element ranging from small to dominant numbers in all lagoons except no. 2 south, the one which most nearly approaches marine conditions. In lagoon no. 5 south, it was extremely abundant, and although a considerable number of early copepodid stages occurred mingled with adults no nauplii were observed. This agrees in general with the observations of Comita (1956) in a more extensive analysis which indicated that the eggs of this species in Imikpuk Lake hatched early in spring, and only copepodid stages are to be found in late July and August. His data show no nauplii after Jul. 31 and the first appearance of adults (copepodid stage VI) was on Aug. 10. In the present collections from lagoon no. 5, adults already outnumbered the other stages on Aug. 6, when the first sampling was done. Comita concluded that *L. johanseni* in Imikpuk Lake produces only one generation a year and that the species winters over in the egg stage. This agrees with the known life cycle of another fresh-water species, *L. macrurus*, discussed by Gurney (1931). Another similarity between the populations of Imikpuk Lake and lagoon no. 5 south was the presence of at least two size groups. This bimodality was not so pronounced in the males as in the females, but some tendency is shown (Fig. 2). The present analysis of the population applies only to the standing crop at the time of sampling, and hence further comparisons cannot be made other than to note that the large-size group was the most abundant. But it cannot be said whether they were produced before or after the small-size group.

TAXONOMIC NOTES

The following observations can be made regarding a few of the species encountered.

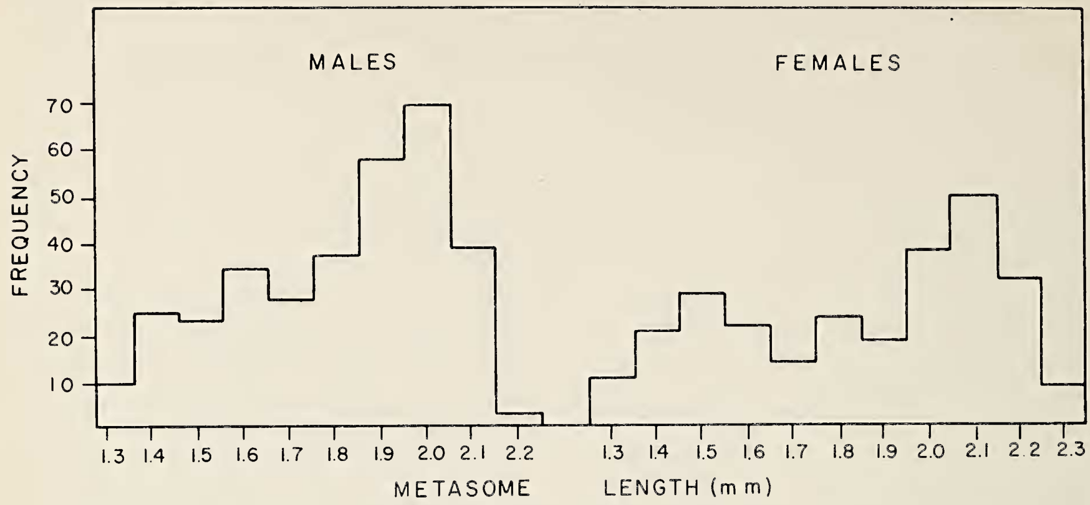


FIG. 2. Length frequency histogram for *Limnocalanus johanseni* adult (copepodid VI) population.

Limnocalanus grimaldi (de Guerne)

A total of 25 specimens was taken in lagoon no. 1 north, mostly near the bottom at a depth of only 3 m. Specimens were compared directly with *L. grimaldi* taken in 1950 in the Beaufort Sea at various stations offshore near Collinson Point and the Colville River. The fresh-water species *L. macrurus* Sars has not been seen for comparison. The Beaufort Sea specimens which were re-examined at this time agree well with the descriptions given in the literature for *L. grimaldi*. The head is not in the least vaulted as occurs in various degrees in *L. macrurus*, and there is only a slight cervical depression (Sars, 1897: pl. 4, figs. 2, 3, 17). The structure of the fifth feet also agrees. The first antennae of the female reach beyond the anterior margin of the anal segment. In the male there are five distinct segments in the distal end of the right antenna beyond the geniculation. The deviations from descriptions of *grimaldi* are mainly in the posterior margins of the fifth thoracic segment. These were smoothly rounded in some cases, but many specimens had the characteristic triangular or spine-like point, and this was sometimes present only on one side. The caudal rami were about eight times as long as broad and were slightly longer in relation to the urosome than given by Sars.

The specimens collected in lagoon no. 1 north are here also considered to be *L. grimaldi*, since they agree in nearly all respects with the Beaufort Sea material. The posterior margin of the fifth thoracic segment was acutely pointed in most specimens, but a few occurred with smoothly rounded margins (a characteristic of *L. macrurus*); there were, however, only four distinct segments in the distal end of the male right antenna beyond the geniculation. This is also a characteristic of *L. macrurus*, although Marsh (1933) states that in exceptional cases there may be five segments. The lagoon specimens were slightly smaller than those from the Beaufort Sea, namely 2.6 to 2.7 mm. as opposed to 2.9 to 3.3 mm. for females.

Since the condition of the fifth thoracic segment is obviously an unreliable character, one is left to choose between the relative specific value of the outline of the head, and the segmentation of the distal end of the male first antennae. Both of these are variable for *L. macrurus*. The habitat presented by lagoon no. 1 north is probably an important consideration, for although it was virtually fresh at the time and place of sampling, it is shallow and so near the sea that it may be reached by very high storm waves. This environmental situation may constitute an interesting natural experiment in which a landlocked population of *L. grimaldi* has assumed some characteristics of its fresh-water counterpart, particularly in the fusion of two of the segments in the distal portion of the male right antenna.

Limnocalanus johanseni Marsh

A comparison of specimens of this species from the lagoons and from collections I made in Imikpuk Lake in 1957 shows only small variations in structure. Mention should be made, however, of some features that are not included in the original description. It was noted that in many specimens the fifth thoracic segment may be smoothly rounded or with only slightly angular outline. Marsh states that this segment is rounded on the sides, and each side is armed with a small spine which may be either sharp or blunt. Apparently inadvertently omitted from Marsh's drawings is a long, heavy seta that occurs on the inner anterior distal angle of the second basis of the first feet.

Centropages abdominalis Sato 1913

Centropages mcmurrichi Willey 1920

Willey (1920) was apparently unaware of Sato's (1913) publication, and described this species as new under the name *C. mcmurrichi* n. sp. His description is without figures, but he considered the species to be identical with a copepod reported and figured by McMurrich (1916), with some reservations, as *C. hamatus* Lilljeborg. Examination of Alaskan material and reference to McMurrich's figures, and to those of Sato (photostatic copies of which are at hand through the courtesy of Dr. Takasi Tokioka and Isamu Yamazi of the Seto Marine Biological Laboratory), and of Mori (1937) leaves little doubt that these species are identical.

Eurytemora pacifica Sato 1913

Eurytemora johanseni Willey 1920

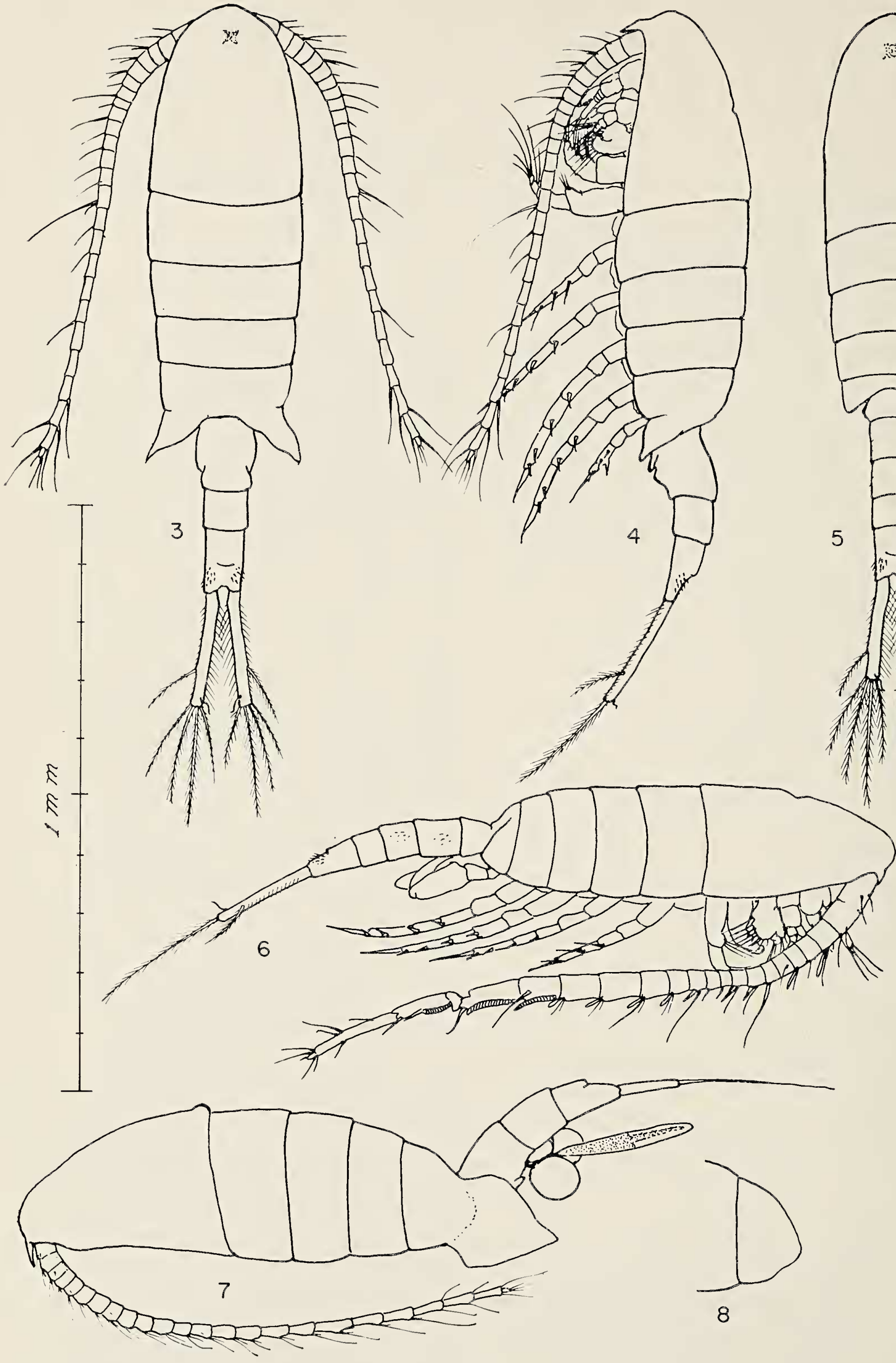
This is a clearly defined species, principally on the basis of the fifth feet in the female (Figs. 7–10). In the female, the fifth thoracic segment is provided with broad triangular wings, but breeding females were also found with this segment smoothly rounded (Fig. 8). The hyaline wing apparently may be shed or fails to develop. In the present study both males and females were found in the same catches. Willey (1920) described the species under the name *E. johanseni* n. sp. Sato described only the adult male, but his figures agree especially with Willey's figures 11 and 12 of the fifth feet. Smirnov (1931) first pointed out the probable identity of the species.

Eurytemora foveola n. sp.

TYPES: Holotype, male, U. S. National Museum no. 105996; allotype, female, USNM no. 105997. Type locality, lagoon no. 6 south.

In lagoon no. 6 south and nos. 1 and 2 north the dominant copepod was this hitherto unknown species. It was present in these lagoons in vast numbers and despite its small size constituted 90 per cent or more of the biomass in the samples from lagoon no. 6 south and no. 1 north where it was actively reproducing and many females were found carrying eggs and spermatophores. In lagoon no. 2 north it was greatly surpassed in mass by the larger cladoceran *Daphnia*. It is closely allied to *Eurytemora gracilis,* both sexes of which were described by Sars (1898) from the lower Yana (Jana) River and, judging from Sars' figures and description, the females may be nearly indistinguishable. The chief differences separating the present species from that of Sars' are structural details in the fifth feet of the males. In view of these small but apparently persistent differences, as shown by examination of a great many specimens, it seems best to designate it a new species rather than a variety of *E. gracilis*.

FEMALE (Figs. 3, 4): Length 1.15–1.25 mm. The body is slender in both dorsal and lateral aspects with about the following linear proportions: metasome (anterior division) 67, genital segment 11, first abdominal segment 6, anal segment 11, caudal rami 17. The metasome is slightly widest in the region of the first pedigerous segment. There is a slight cephalic depression, but no medial knob on the posterodorsal margin of the cephalic segment. (In *E. gracilis* the greatest width appears to extend somewhat farther forward according to Sars' pl. 8, fig. 8; and in his fig. 9, the lateral profile also differs in that his species is relatively thicker through the midbody and the cephalic



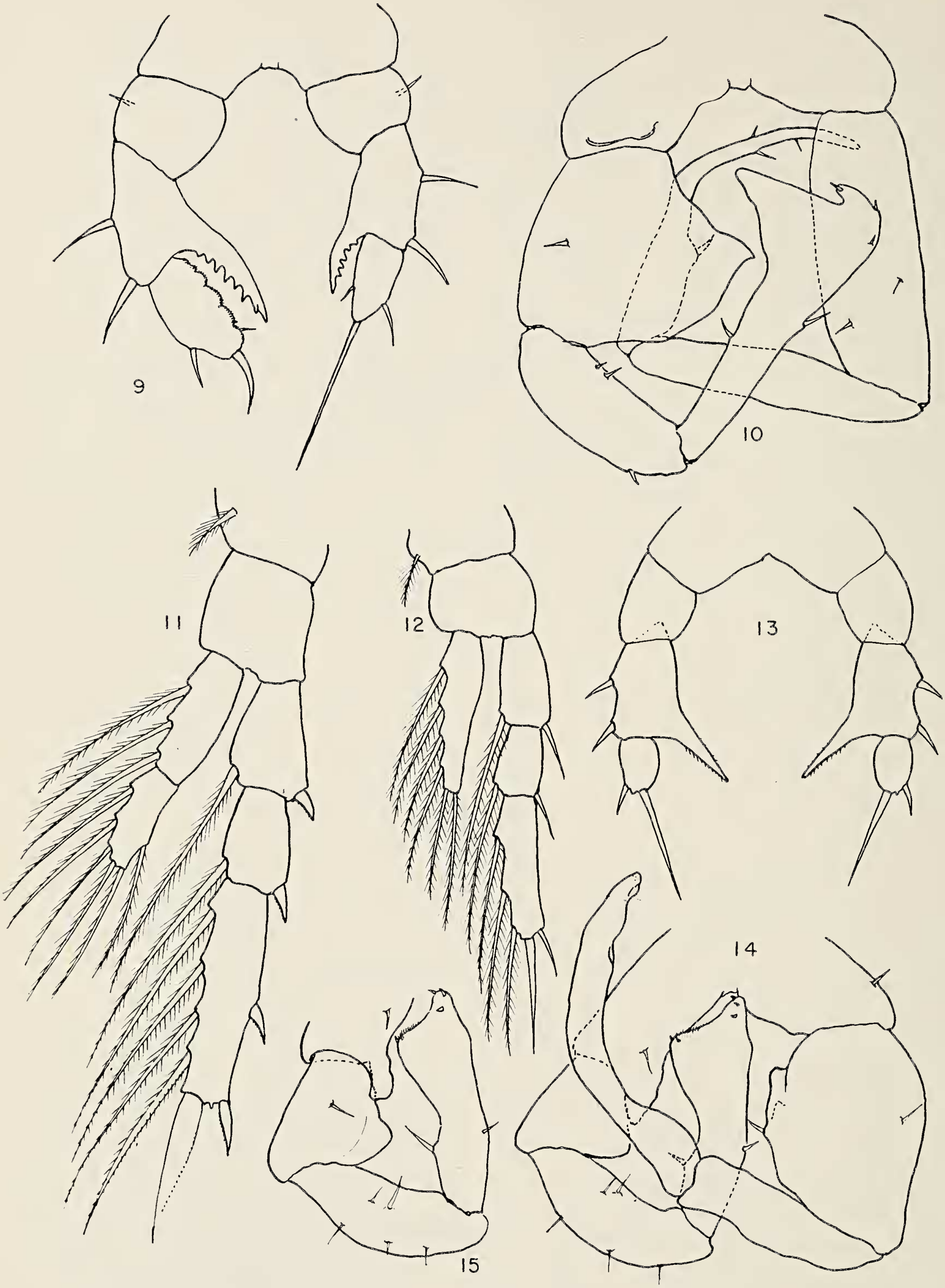
FIGS. 3–6. *Eurytemora foveola* n. sp. 3, Female, dorsal; 4, female, lateral; 5, male, dorsal; 6, male, lateral.

FIGS. 7–8. *Eurytemora pacifica.* 7, Female, lateral with eggs and spermatophore; 8, female, lateral outline of fifth thoracic segment occurring in some adults.

segment is slightly raised dorsally at the hind edge.) The fifth thoracic segment is extended into laterally projected "wings" that vary considerably in length and hyalinity. Many adult specimens were observed in which the left wing was only slightly developed, although the right wing was always well developed. The first antennae reach to, or slightly beyond, the fifth thoracic segment. The genital segment is nearly symmetrical and only slightly constricted laterally. It bears no lateral expansions but in lateral aspect has a rather conspicuous genital operculum. The anal segment is armed dorsolaterally with patches of fine spinules, best observed in aqueous media. (Sars states that in *E. gracilis* "the last caudal segment is perfectly smooth without any trace of the densely crowded spikes clothing the dorsal face of this segment in *T.* (*E.*) *hirundoides*.") The caudal rami are provided with fine "hairs" on both their inner and outer margins. The longest caudal setae are only slightly longer than the rami. The terminal spine of the exopod of the second, third, and fourth swimming feet (Fig. 11) is cultriform as in *E. gracilis*. The fifth feet (Fig. 13) are symmetrical as in *E. gracilis,* and the first exopod segment bears a heavy, slightly setose, unguiform process directed inward. There are two spines on the outer margin of this segment. The end segment is short and bears one long terminal spine and one short outer spine. The terminal spine of the exopod of the third and fourth feet is somewhat broadened in the middle and is shorter than the end segment. In the male this spine is longer and more slender. The genital operculum is rounded (Fig. 16) in contrast to the pointed operculum of the closely related species *E. affinis* as described and figured by Gurney (1931), and which he considers synonymous with *E. hirundoides*.

MALE (Figs. 5–6): Length 1.0–1.2 mm. The body is slender and nearly parallel-sided anteriorly but tapers posteriorly. The body proportions are about as follows: metasome 57, urosome (without caudal rami) 25, caudal rami 15. As in the female, the anal segment bears dorsal patches of tiny spinules. The caudal rami have fine "hairs" on the inner and outer margins. The right geniculated first antenna has 25 segments with moderately heavy spines on segments 8, 9, and 12. The fifth feet (Figs. 14, 15) are asymmetrical, uniramous, and each exopod consists of two segments. The specific characters separating the species from closely related forms are seen mainly in the basal segments and in the relative proportions of the segments of the rami. At the inner proximal margin of the second basipod of the right foot there is a well-defined rounded projection and associated smooth notchlike depression suggesting the specific name. The inner margin of the first basipod of the left foot projects downward, forming an irregular blunt process overlapping about one-third the length of the second basipod. The second basipod is broadened with an inward expanse forming a dull flange along the long axis of the segment. Sars' plate 8, figure 16, shows no trace of these three features for *E. gracilis*. Otherwise the exopod segments agree with that species which, however, appears to have a shorter first exopod segment on the left foot. The uncertain species described by Kiefer (1938) also differs in the absence of these characters and in the shape of the second basal segments of each foot. The second antennae and the mouth appendages of *E. foveola* are similar in the two sexes and appear to have no specific character except perhaps for the shape of the mandibular blade (Fig. 17). Few illustrations of other species are available with which to make comparisons, but the gap between the first and second tooth is considerably wider than that figured by Gurney (1931) for *E. affinis*, Sars (1903) for *E. velox*, and Wilson (1953) for *E. yukonensis* and *E. composita*.

It should be mentioned that a single damaged female specimen of a *Eurytemora* was collected by the Canadian Arctic Expedition offshore near Cape Thompson. Willey (1920) tentatively referred it to *E. gracilis*. It is not possible to conclude what species he dealt with but the proximity of the catch to the lagoons so richly populated by *E. foveola* makes it highly likely that it had been washed out from a nearby lagoon. Although there may be an intermittent present-day connection between the Yana River population and that in the Cape Thompson area, it must be a very tenuous one for a fresh- or brackish-water species, especially in view of the prevailing oceanic circulation northward through



FIGS. 9–10. *Eurytemora pacifica.* 9, Female, fifth feet; 10, male, fifth feet.

FIGS. 11–15. *Eurytemora foveola* n. sp. 11, Female, fourth foot; 12, female, first foot; 13, female, fifth feet; 14, male, fifth feet; 15, male, left fifth foot.

the Bering Strait and eastern Chukchi Sea. However, other studies indicate that plankton organisms may be transported across rather well-defined currents by eddy diffusion, and the prevailing currents along the Siberian coast might bring expatriates into the western portion of the Chukchi Sea. Brodskii (1950) does not include *E. gracilis* in his list of copepods of the Polar Basin.

Gurney (1931) has pointed out the specific variabilities that may occur in several species of *Eurytemora* living in different habitats in Europe. It remains to be shown to what extent *E. foveola* may also be morphologically variable in diverse environments. The great range of Alaskan lagoon and estuarian habitats and the seven or more species on the Alaskan coast should provide excellent material for such a study.

SALINITY RELATIONS

Although the data are too few to give more than a glimpse into the salinity tolerances observed for the various copepod species identified, still it is worthwhile to record such analyses as can be made from this area. Figure 19 appears to divide the copepods encountered into three groups with respect to salinity range and preference. (1) *Acartia bifilosa* and *A. clausi* occurred over nearly the whole range encountered but not below 0.83 ‰ at which value only relatively few specimens were found, especially *A. clausi*. The former was the dominant copepod in the two lagoons having highest salinities 6.42 to 15.96 ‰. (2) *Cyclops* spp., *Eurytemora canadensis*, and *Limnocalanus johanseni* ranged from 0.16 to about 7 ‰ but appeared to thrive best at 0.73 to 0.83 ‰. *Eurytemora foveola* n. sp. probably belongs to this group but stands somewhat alone in occurring only in ranges from 0.18 to 0.73 ‰ at which salinities it was dominant. *Limnocalanus grimaldi*, in this unique situation, occurred also at only a very low salinity, but elsewhere in the arctic it has a strong affinity for the sea. (3) The final group, into which *Acartia bifilosa* and *A. clausi* extended, are the characteristically marine forms occurring in lagoon no. 2 south with salinities of 14.31 to 15.96 ‰. Only in the more saline lagoons, nos. 2 and 4 south, was there any appreciable range in salinity from top to bottom. These two lagoons are also probably the ones most readily invaded by marine forms, but the influx of fresh water appears also to be quite high in these lagoons. Hence the communities are probably more or less transitory and fluctuate with repeated recolonizations.

Whittaker and Fairbanks (1958) have studied the occurrence of various nonmarine copepods in inland lakes and ponds of different salt content. The salinities and fauna they dealt with are of course not directly comparable with those of coastal lagoons, since the ratio of salts differ and their more saline species have different taxonomic relationships. But it is interesting to note that the transition between saline and fresh-water communities in their study was "somewhere between 425 and 875 ppm" for most bodies of water. If a comparison is justified it must be with the fresh-water fauna of the lagoons, then lagoons nos. 1, 3, 5, and 6 south and 1 and 2 north could be expected to foster truly fresh-water species and the occurrence of *Eurytemora canadensis* and *Limnocal-*

FIGS. 16–18. *Eurytemora foveola* n. sp. 16, Female, genital field and operculum, ventral; 17, male, mandibular blade; 18, male, labrum.

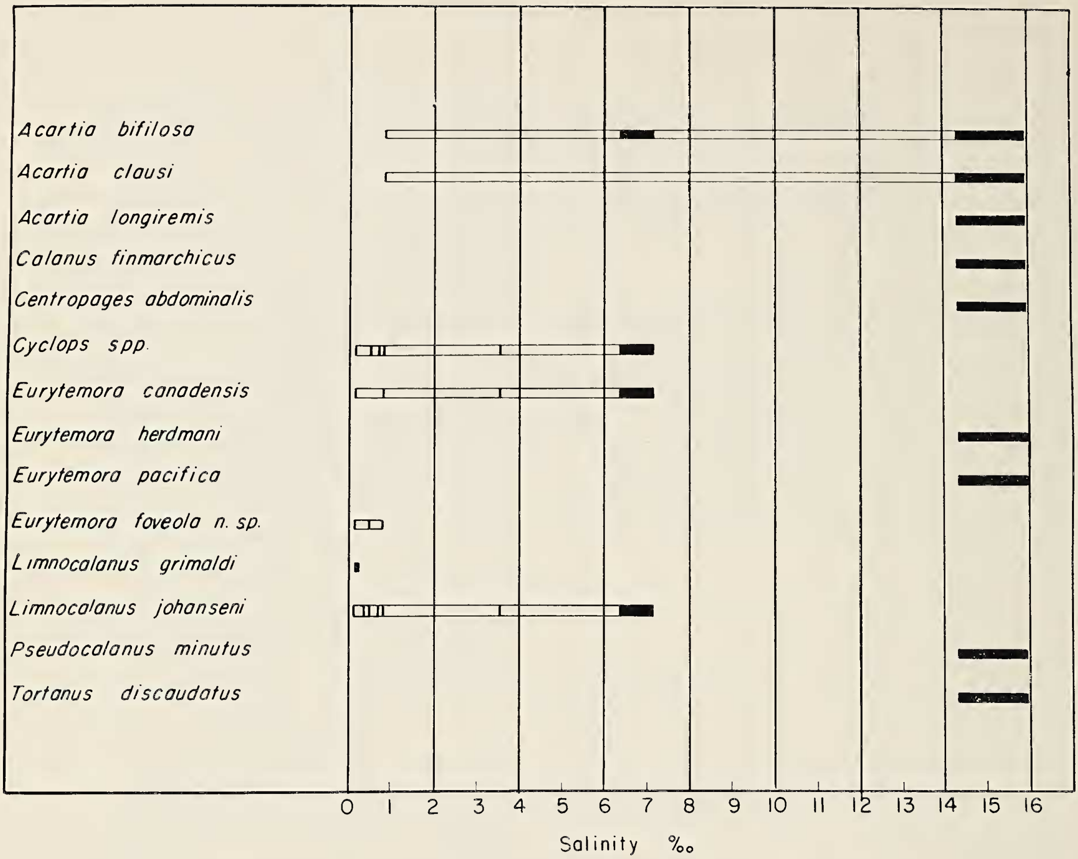


FIG. 19. Total salinity ranges over which certain copepod species occurred in nine coastal lagoons near Cape Thompson, Alaska, 1959. Cross bars denote salinity at stations of sampling.

anus johanseni in most of these and in lagoons nos. 4 and 7 south would mark them as quite euryhaline but with preferences for the lower salinities.

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